Close-Out Report

On the

Department of Energy
Review Committee Report

on the

Review

of the

D -Zero Detector Upgrade

June 18, 1999

United States Government Department at

memorandum

DATE: April 14, 1999

FIEPLY TO ATTN OF: Office of Science

SUBJECT: CDF and D-Zero

TO: Dan Lehman, SC-81

I am requesting that you carry out an integrated technical, cost, schedule, and management review of the upgrades to the Fermilab collider detectors, CDF and D-Zero. These upgrades in preparation for Run II at the Fermilab collider are among the highest priorities in the U.S, high energy physics (HEP) program. As such, their successful completion is of the utmost importance. With approximately one year remaining before Run 11 is scheduled to begin, it is appropriate to conduct a review, placing emphasis on those parts of the CDF and D-Zero upgrades remaining to be completed, on the overall management and integration of these upgrades, and on the schedules.

In the near future, 1 will provide you with a detailed charge for this review. A tentative date for the review of June 15 -1 8, 1999, has been established in consultation with the Laboratory. I would appreciate receiving a formal report of your review by July 31, 1999.

We appreciate your assistance in this matter. These reviews are an essential management element in the Department of Energy's oversight of the CDF and D-Zero upgrades.

JohnR.O'Fallon Director
Division of High Energy Physics

cc: S. P. Rosen, SC-20
Jack Ritchie, SC-223
Pat Rapp, SC-223
John Peoples, FNAL
Ken Stanfield, FNAL
Robert Wunderlich, Fermi Group

Department of Energy Review of the CDF/D-Zero Detector Upgrade Projects

REVIEW COMMITTEE

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Department of Energy Review
Of the
D-Zero Detector Upgrade Project

REPORT OUTLINE/WRITING ASSIGNMENTS

D-Zero Detector Upgrade Project Review

Executive Summary			S. Tkaczyk
1.	Introduction		P. Phup
2.	Technical Systems Overview		
	2.1	Silicon Tracker (WBS 1.1.1) and Tracking Electronics (WBS 1. i .5)	J. Alexander/T. Barker
	2.2	Fiber Tracker (WBS 1.1.2)	R. Rusacki/D. MacFarlane
	2.3	Muon Detectors (WBS 1.3)	D. MacFarlane
	2.4	Installation and Commissioning	J. Thaler/P. Rapp
3.	Cost		S. Tkaczyk
4.	Schedule and Funding		G. Sanders
5.	Management (WBS 1.0)		G. Sanders

Appendices.

A. Charge Memorandum
B. Review Participants
C. Review Agenda
0. Cost Tables
E. Schedule Tables
F. Organization Charts
G. Action Items

First person identified is lead.

Silicon Detector (SMT)

Finding

- Huge project - 1248 sensors, 5 types, complex ass'y

  Sensor delivery has experienced significant delays but

  - increased surveillance
  - new project engineers
  - alternate vendors
  - H disk fabrication (Elma) nearly complete
  - 61 % of sensors are in hand

  9 chip sensors have shown sustained upturn in prodn

- 6 chip and F wedge not demonstrated yet

- HDI deliveries now almost complete.

- Low mass cable not yet in acceptable form

- Ladder and Disk assembly just getting started
  - major eqpt in place
  - most personnel in place and trained
  - fixturing is not complete

Comments

- Sensor delivery:
  - hard work and perseverance with Micron has given grounds for cautious optimism;
  - history indicates need for continued vigilance.

- Fallback plans are not well developed but plausible scenarios have been identified.

- Response to HDI situation was aggressive and productive

- Low mass cables are a potential trouble spot (though fall back exists)

- Ladder and Disk assembly is well organized and planned, but not yet battle tested. Adequate staffing and early procurement and qualification of fixturing could save headaches later.

Recommendations

1. Continue surveillance at Micron.

2. Further develop contingency plans.

3. M3 milestone: decision to forge ahead or fall back to a contingency plan.

2.2 Fiber Tracker (WBS 1.1.2)

Roger Rusack, David MacParlane, Jack Ritchie.

Findings:

The fiber tracker consists 8 concentric cylinders of lengths up to 2.6 m with a total of 77,000 fibers mounted on them. The light from the fibers is transported to cryogenic VLPC cassettes via optical wave-guides. There are a total of *105* VLPC cassettes needed for the experiment.

The fiber tracker has made considerable progress since the last review and many unexpected$_1$ technical problems have been resolved. Most notably there have been problems with the manufacture of the moulds for the ribbons, with the scintillating fibers to optical wave-guides connector and with the flex cables in the VLPC cassette. The resolution of these and other problems has delayed the as-yet-to be achieved milestone First Cylinder Complete by 49 weeks since the January '98 review. These delays have also postponed the start of the cassette production.

The schedule presented allows only six months for the whole detector assembly compared to their January '98 estimate of eleven months. The current schedule has the full detector completed by January 24, '99. There are no provisions for any delays within this schedule.

Production of the both the fiber tracker or the VLPC cassettes has not yet started. The mounting system of the fiber cylinders has not yet been proven. The project engineer who was responsible for this critical item retired in May '99.

Comments:

The fiber tracker poses a significant schedule risk for the detector. The achievement of their schedule with their level of resources is implausible.

They need to move as rapidly as possible into a full production mode and the resources necessary for the operation of two shifts for both the fiber ribbon and the cassette production need to be provided. The upgrade management should pay very close attention to the progress of this production since even with these extra resources the fiber tracker may well delay the installation schedule.

The responsibility of setting up and operation of the production line should be in the hands of a full-time production manager as soon as possible to allow the fiber tracker project manager to give his full attention to the remaining technical problems.

Recommendations:

1) Move promptly into full production of both the fiber-tracker and the cassettes.
2) Provide sufficient resources to set up two shifts for the fiber ribbon and cassette production.
3) Establish milestones so that production can be monitored by the DO management.
4) A full-scale effort to test and debug the cylinder mounting system should be carried out by September.

2.3 Muon Systems

Findings

- Upgrades to central muon system largely in place
- Forward trigger pixel counters produce; assembly of octants underway, confirming reasonable production rate
- 5 out of 48 forward tracker MD at Fermilab, a 40 week delay with respect to the baseline milestone
- Remainder of MDTs to be completed at JINR by October
- Development of MDT octant production procedures underway
- Complete readout chain tested with PDT chamber
- Making transition to front-end board and readout card production

Comments

- Large and active muon team
- Required octant production rate appears achievable, but tight with respect to installation requirements
- Rate can and should be increased to create more schedule contingency

Recommendations

1. Establish completion of MDTs as a new M2 milestone
2. Increase the rate of pixel and MDT octant production, in order to provide some schedule contingency
3. Continue to provide local financial support for Russian physicists who are crucial to octant production and QC, and DAQ software development

2.4 Installation and Commissioning

Findings

The DO upgrade project has made significant progress since the last review in January 1998. The project is about 80% finished, and completion is in sight. A significant part of the remaining work consists of installation and commissioning of the detector.

The DO collaboration held an online workshop in June 1999. This workshop trained about 70 collaboration members to write online software. A second such workshop will be held in June/July 1999

Comments

Commissioning of the DO detector is, technically, outside the upgrade project. However the present DO baseline schedule requires that commissioning (without beam) take place during installation. Because the schedule is so tight, this requires that critical parts of the data acquisition ~AQ) and trigger hardware and software be completed ahead of time so that no delays will be incurred.

The DAQ and trigger hardware appears to have a timely schedule. However, significant delays have occurred in the last year, so it would be prudent to reevaluate the schedule to ensure that those components will be done on time. It would also help to accelerate the completion of other detector components (e.g., by increasing the number of personnel) in order to loosen the installation schedule.

The people who will write the software identified. Equally importantly, they are not of the construction. This decoupling is important to the maintenance of a tight installation/commissioning schedule.

Not all engineering necessary for installation is complete. It is important that this work be undertaken soon enough to allow for unforeseen problems.

Recommendations

1. Reevaluate the DAQ and trigger installation schedule to ensure that the installation sequence is compatible with commissioning needs.

2. Reevaluate the personnel needs for installation and commissioning to ensure that delays due to manpower shortages do not result.

Tkaczyk 6118199 11:49AM

3.0 Cost

Findings:

The D-Zero project developed a new bottoms-up cost estimate for Materials and Services M&S) as well as the Solenoid, in the March - April 1999 time frame. The total cost for M&S and Solenoid, at *$45,478* K, is unchanged from the January 1998 review. There have been change control actions since the previous review, which have resulted in utilization of contingency, as indicated in the below table; 79 percent of the total M&S and Solenoid cost has been obligated and the remaining contingency is 27 percent of the unobligated cost.

M&S and Solenoid Costs
(In thousands of then year dollars)

	1198 Review	6/99 Review	Changes	Obligated	Estimate toComplete
M&S	35,134	38,533	3,399	31,113	7,420
Solenoid	4,935	4,936	1	4,814	122
Contingency	5,409	2,009	-3,400	0	2,009
Total	45,478	45,478	0	35,927	9,551

The major changes since the January 1998, review were in the areas of Silicon Tracker ($1.3 million), Fiber Tracker ($0.9 million), Level 3 Trigger ($0.3 million), Cosmic Ray Scintillator ($0.3 million), and Trigger Framework ($0.3 million). Of the $2.0 million remaining in contingency, the project has identified *$0.5* million of possible additional changes, which are currently under evaluation.

Costs for Salary, Wages and Fringes (SWF) were not presented but were addressed in terms of personnel levels. No problems were identified.

Comments:

The contingency remaining for the M&S and Solenoid costs at this time appears reasonable. However, the possible impact due to the need for additional labor has not been evaluated.

Recommendations:

None

Gary Sanders

4. SCHEDULE AND FUNDING

4.1. Schedule

Findings

DO is projecting that the readiness for collisions milestone is July, 2000. This is a slip from the original November, 1999 baseline. Half of this delay was apparent at the last major review in January 1998.

The most significant delays have been in the fiber tracker subsystem that lost 49 weeks since the last review. This delay was dominated by technical problems such as the many assembly processes involving adhesives. They reported that most of the technical problems have now been mastered. The major processes, components and tooling are now ready for production assembly.

Similarly, the silicon tracker has experienced a number of delaying problems including persistent supplier problems with several of the silicon sensor varieties required for the tracker. Where needed, alternate suppliers have been placed under contract, improved processes have been utilized to achieve accelerated production; and surveillance has been increased. At least one sensor variety, the F disks, remains a concern.

The remaining schedule has several parallel critical paths in production, installation and commissioning. Failure in any of these paths will result in delay of the final delivery milestone for the detector.

The fiber tracker and the silicon subsystem must be installed as a single assembly. This offers little prospect for phased installation.

The project seems well prepared for phased commissioning of subsystems as they arrive.

Comments

Several subsystems are nearing completion or substantially complete. A great deal has been accomplished and the ongoing assembly at Fermilab is impressive. The team is dealing effectively in many areas with a very demanding project at a critical stage The readiness for installation and commissioning and the active steps taken to involve the collaboration in commissioning are favorable.

Achieving the July, 2000 delivery of a complete DO upgrade detector is a very aggressive goal, and given the brittleness of the schedule we believe that it is unlikely that this delivery can be accomplished. Any failures in deliveries of silicon sensors, or in silicon or fiber tracker assembly would add significant delay.

The fiber tracker production schedule is extremely tight. The team is ready for production but has not made the transition from development to production nor taken steps to add needed effort and to proceed vigorously in order to create potential schedule slack in this critical path.

The schedule has recently been updated, but in light of our concern that it cannot be accomplished as planned, the management of DO should scrutinize this schedule and the delivery of the detector for collisions. It is essential that the project managers have a set of measurement indicators for progress in the remaining months.

Recommendations

1. Reevaluate the schedule and the final detector delivery date.
2. Develop, in consultation with DOE, a series of new milestones which track progress toward completion of the detector. These should reflect rate of progress on key systems.
3. Maintain continuous and comprehensive surveillance of all critical processes at vendor sites where schedule-pacing items are being fabricated.
4. Develop fallback plans to react to potential delivery shortfalls of key components.
5. Work with the Laboratory to fully staff schedule-critical production efforts.

4.2. Funding Findings

According to the project management, the finding applied has been consistent with the project planning.

Comments

There appears to be sufficient finding to support completion of the project.

Recommendations

None.

5. Management

Findings

Labor resources at the Laboratory were described for the production and installation effort. Planning of effort for commissioning is underway.

Comments

Effort on additional planning of the endgame is recommended above in section 4.1.

Manpower available appears adequate in general. However, in the fiber tracker the planned staffing for production should be brought promptly to full strength. There may be other areas requiring prompt attention, as well.

Recommendations

I. Review and continually update all resource plans for completing the detector.